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The Effects of CMMI®
on Program Performance

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Framing the Issues

The Good News

Disciplined process improvement <u>can</u> lead to better program performance

- Meeting Schedule and cost commitments
- Product quality and fitness for use

Many examples demonstrate this quantitatively & quite convincingly

- Presented at this conference and elsewhere
- http://www.sei.cmu.edu/cmmi/results.htm

The Not So Good News

Skepticism remains
- About the value of investing in improved process capability
- In both Systems Engineering & Software

Instances exist of less than stellar product delivery
- By high maturity organizations as well as low

More and better evidence is needed to:
- Convince others who are not us...
- & support evidentially based process improvement

How Can Both Be So?

Often Heard "Answers"

"Maturity Levels are meaningless"

"The high-maturity organizations are not applying high-maturity practices to these unsuccessful programs."

"Process is just one element of program success. The program failures may arise from weaknesses in the people or the technology applied to the project."

"A low-maturity acquirer prevents the organization from performing at a high maturity level."

"The programs are unprecedented, and the required technology is not available."

… and many more

The "Real" Answer

We don't know !

Most of the evidence comes from case studies

- Which can be accused of "cherry picking"
    - Fairly or not

- Failures are rarely reported publicly

- Circumstances differ
    - The results <u>can</u> be very instructive in some instances
    - But, they may <u>not</u> be applicable elsewhere

More & different kinds of evidence are needed

- To support good business & engineering decisions
- Of course, some will never be convinced...

What Else Is Needed?

Credible comparative evidence is sorely needed

- Proactively elicited from all parties

- To better demonstrate the statistical relationships between process capability & program performance
  - Controlling for other characteristics that may affect both

- Using the same measures to benchmark:
  - Process capability
  - Performance outcomes
  - Product characteristics
  - Other pertinent contextual differences

What Causes Program Failure?

Are invalid maturity level appraisals the only cause?

There are many other possible reasons

- Requirements volatility

- Contract revisions & non contractual scope creep

- Criticality and complexity

- Lack of precedentedness & domain experience

- New & unproven technologies

- Maturity level mismatches & other poor relationships among acquirers, contractors & subcontractors

Measuring Program Costs & Benefits

Broadly applicable quantification of costs & benefits remains elusive

- Complicated by the lack of a broadly accepted definition of Systems Engineering

- Insufficient identification and tracking of Systems Engineering costs & efforts

- Exacerbated by increasing complexity & size of systems & Systems of Systems

Our Approach

Purpose

Initial focus on demonstrating the effectiveness of Systems Engineering

Also allows us to address quantitatively:

- The reasons why programs from high maturity organizations sometimes fail
- The likelihood of program failure as a function of organizational process maturity

A Comprehensive Survey

- Of defense contactors & subcontractors
- In collaboration with NDIA Systems Engineering Division to reach a broad constituency

Focus on Systems Engineering

Focus on industry members of NDIA that are prime contractors & subcontractors

- Collect feedback from project / program managers

Worked with a committee of respected systems engineers to:

- Come to agreement on a workable definition of Systems Engineering
  - Not an easy task?
  - Agreed early to focus on CMMI processes
    ... without encouragement from the SEI
- Provide domain expertise on other aspects of survey content
- Help craft & implement a viable sample selection plan

Finding the Answer

This survey addresses <u>individual programs</u>

- It assesses key SE practices used on those programs
  - *The assessed practices are derived from the CMMI*

- It collects context information for those programs
  - *Acquirer capabilities, technological difficulty, contractor experience, etc.*

- It collects performance metrics on those programs

Analysis of the survey data will enable us to see correlations between program performance and:

- CMMI practices (individual and ensemble)

- Other program characteristics

Narrowing the Scope

CMMI-SW/SE v1.1
- 22 Process Areas
- 157 Goals
- 539 Practices
- 402 Work Products

Systems Engineering Filter

- 13 Process Areas
- 27 Goals
- 75 Practices
- 185 Work Products

Size Constraint Filter

- 10 Process Areas
- 19 Goals
- 34 Practices
- 63 Work Products
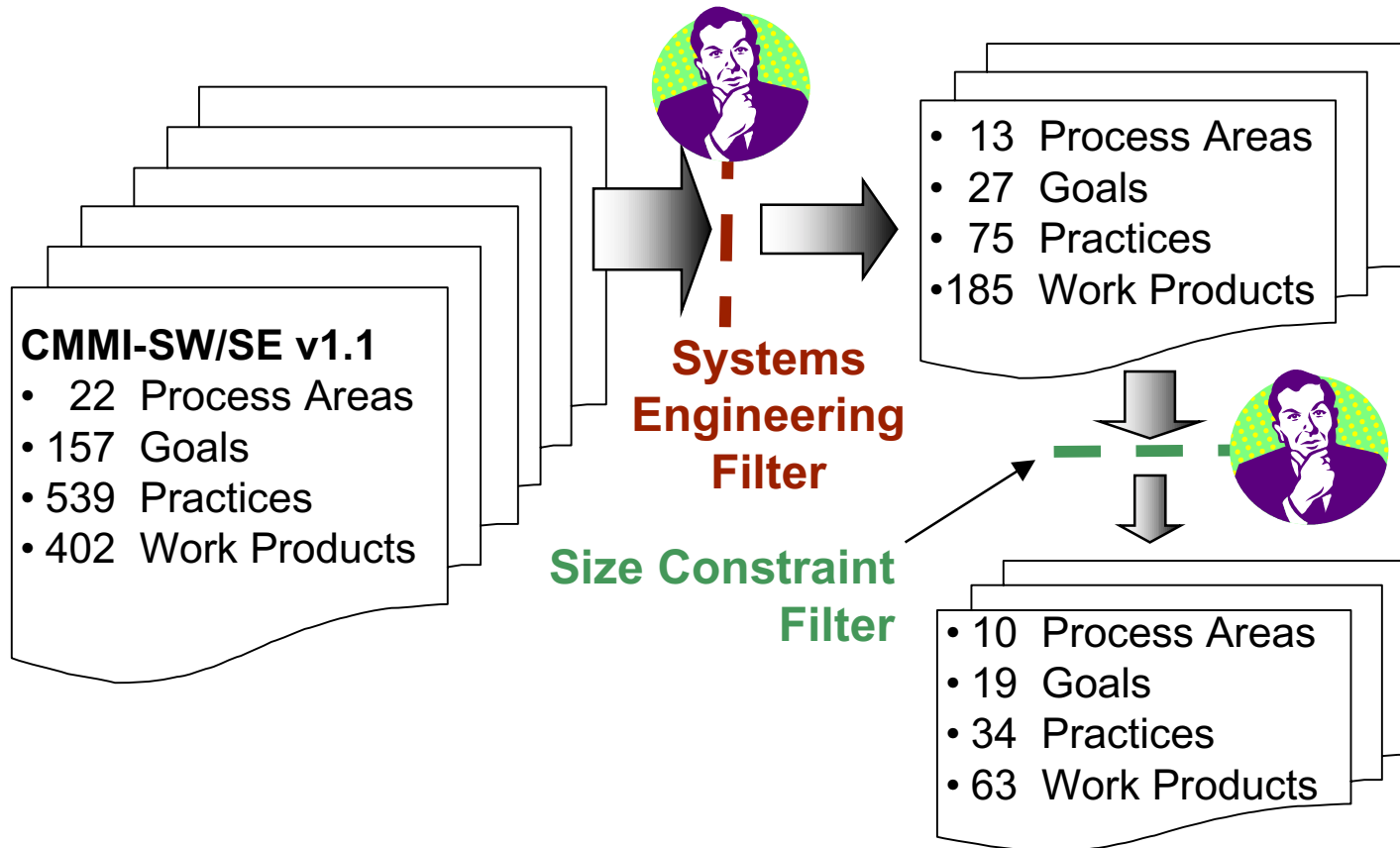
Eliciting Accurate & Honest Answers

Can be difficult to elicit sensitive information from defense contractors

Reticence to:

- Disclose proprietary advantages
- Admit weaknesses publicly
- Compromise future business opportunities

Crucial to assure (& deliver) strict non disclosure of all information provided

A Promise of Anonymity

To elicit honest answers without:

- Compromising business assets
- Threat of reprisal

Necessary for the survey results to be accurate and useful for all concerned

- Including the participating organizations

Survey respondents directed to a web portal

- Obtain a randomly assigned URL
- Known neither to the SEI or their own management

Sample Selection & Implementation

Committee members

- Contact representatives of key organizations to request their participation in the survey

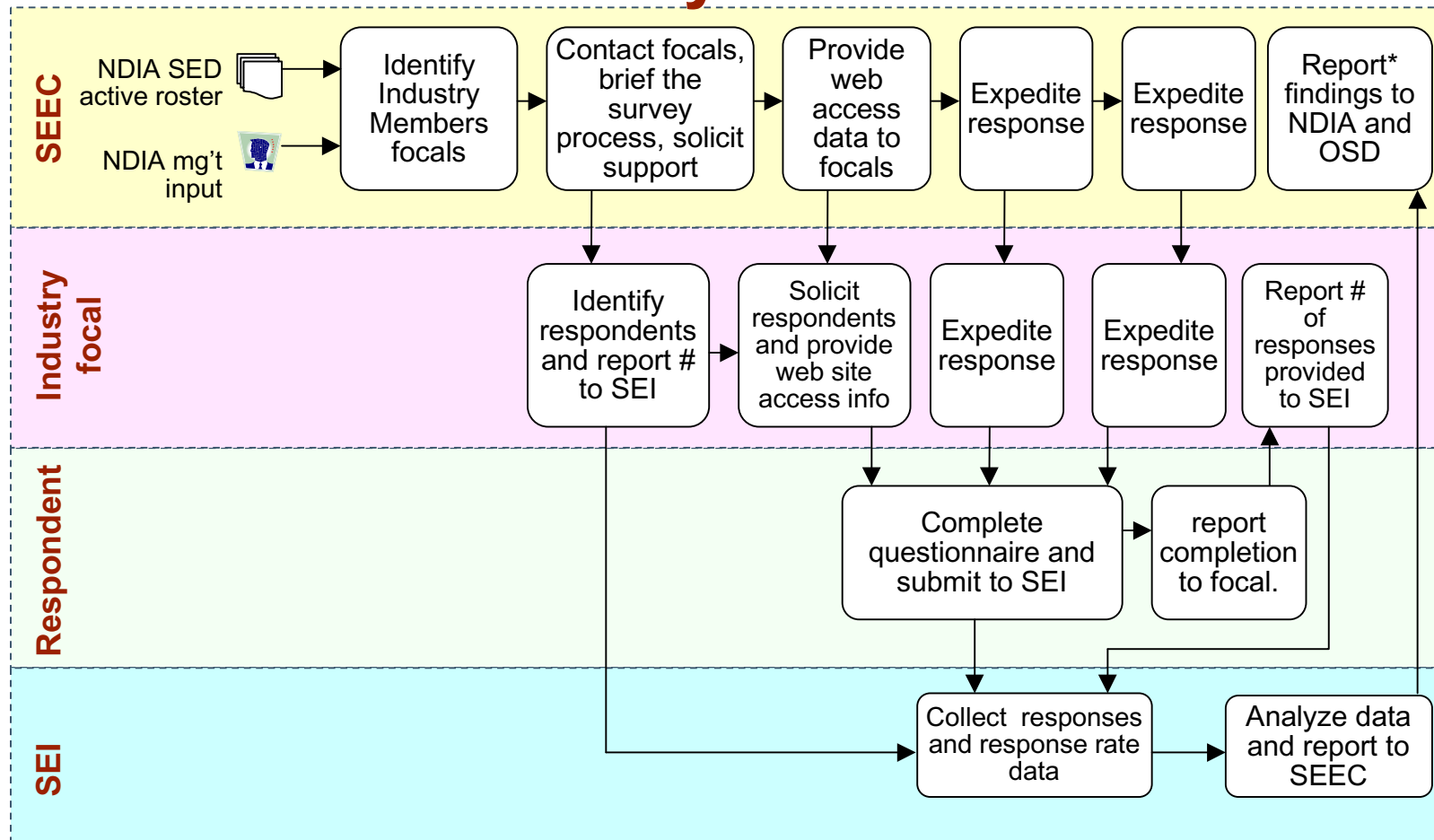- Remind them to have their people complete the survey

Organizational points of contact

- Obtain needed commitment from senior management

- Choose survey respondents without regard to program success

- Remind the respondents to complete their forms on a timely basis

Step 6:
Execute the survey

* Report to include suggested recommendations and actions

SEEC

- NDIA SED active roster
- NDIA mg't input

→ Identify Industry Members focals → Contact focals, brief the survey process, solicit support → Provide web access data to focals → Expedite response → Expedite response → Report* findings to NDIA and OSD

Industry focal

Identify respondents and report # to SEI → Solicit respondents and provide web site access info → Expedite response → Expedite response → Report # of responses provided to SEI

Respondent

Complete questionnaire and submit to SEI → report completion to focal.

SEI

Collect responses and response rate data → Analyze data and report to SEEC

The Survey Instrument

Self-administered
- Formatted for web-based deployment
- Option for off-line completion

Confidentiality
- No elicitation of identifying data
- Anonymous response collection
- Responses accessible only to authorized SEI staff

Integrity
- Data used only for stated purpose
- No attempt to extract identification data

Self-checking

Section 1
Context
(Program Characterization)

Section 2
Process Capability
(Systems Engineering Evidence)

Section 3
Project / Program Performance Metrics

Contextual Measures Include

Product characteristics

Contractual obligations

Project context

Organizational context

Section 1: Characterization
The objective of this section is to gather information to characterize the project under consideration. This information will assist the survey analysts in categorizing the project, and the executing organization to better understand your responses.

1.1	**Project** – information to characterize the specific project under discussion. Size, stability, lifecycle phase, subcontracting, and application domain are among the parameters used for program characterization.
1.1.1	What phases of the integrated product lifecycle comprise this project (check all that apply), and what phase are you presently executing (check 1)? **Included in project (check all that apply** **Current phase (check 1)** r r Concept Refinement r r Technology Development and Demonstration r r Development r r Manufacturing r r Verification r r Training r r Deployment r r Operation r r Support r r Disposal
1.1.2	What is the current total contract value (US$) of your project? $ _____
1.1.3	What was the initial contract value (US$) of your project? $ _____
1.1.4	How many contract change orders have been received? _____

SAMPLE

Process Capability

Process definition
Project /program planning
Risk management
Requirements development
Requirements management
Trade studies
Interfaces
Product structure
Product integration
Test and verification
Project / program reviews
Validation
Configuration management

Section 2: Systems Engineering Evidence			Strongly Disagree	Disagree	Agree	Strongly Agree
Rate your agreement with the following statements						
2.1	**Process Definition**					
2.1.1	This project utilizes a documented set of systems engineering processes for the planning and execution of the project		r	r	r	r
2.2	**Project Planning**					
2.2.1	This project has an accurate and up-to-date Work Breakdown Structure (WBS) that …	a. …includes task descriptions and work package descriptions	r	r	r	r
		b. … is based upon the product structure	r	r	r	r
		c. …is developed with the active participation of those who perform the systems engineering activities	r	r	r	r

Program Performance

Uses measures common to many organizations

- Earned Value
- Award Fees
- Technical Requirements Satisfaction
- Milestone Satisfaction
- Problem Reports

Section 3: Project Performance Metrics					
3.1	**Earned Value Management System (EVMS)**				
	Rate your agreement with the following statements	**Strongly Disagree**	**Disagree**	**Agree**	**Strongly Agree**
3.1.1	Your customer requires that you supply EVMS data?	r	r	r	r
3.1.2	EVMS data is available to decision makers in a timely manner (i.e. current within 2 weeks)?	r	r	r	r
3.1.3	The requirement to track and report EVMS data is levied upon the project's suppliers.	r	r	r	r
3.1.4	Variance thresholds for CPI and SPI variance are defined, documented, and used to determine when	r	r	r	r

What's Next?

Survey Status

Survey instrument development complete

- Web deployment complete
- Pretest in progress

Respondent identification in progress

Response collection through early February

Data analysis and report by 2Q CY2006

Risks

Respondent selection takes longer than planned

Response rate is too low to provide confidence in generalizability

- The committee liaisons & organization focal points of contact need to remind people to reply

Respondent selection or survey responses will be biased

- May need to allow more time for people to reply
  - To avoid excluding the busiest people and at-risk projects
- Crucial for senior management to encourage honest & forthright answers

How Can <u>You</u> Help?

Agree to have your organization participate if you are contacted by a committee member

- Select respondents without regard to their program success

- Provide encouragement, & resources, for the respondents to complete their surveys
  - Honestly & openly
  - Without fear of reprisal

Encourage others to participate

- As potential respondents & in the respondent selection itself

Systems Engineering Effectiveness Committee

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